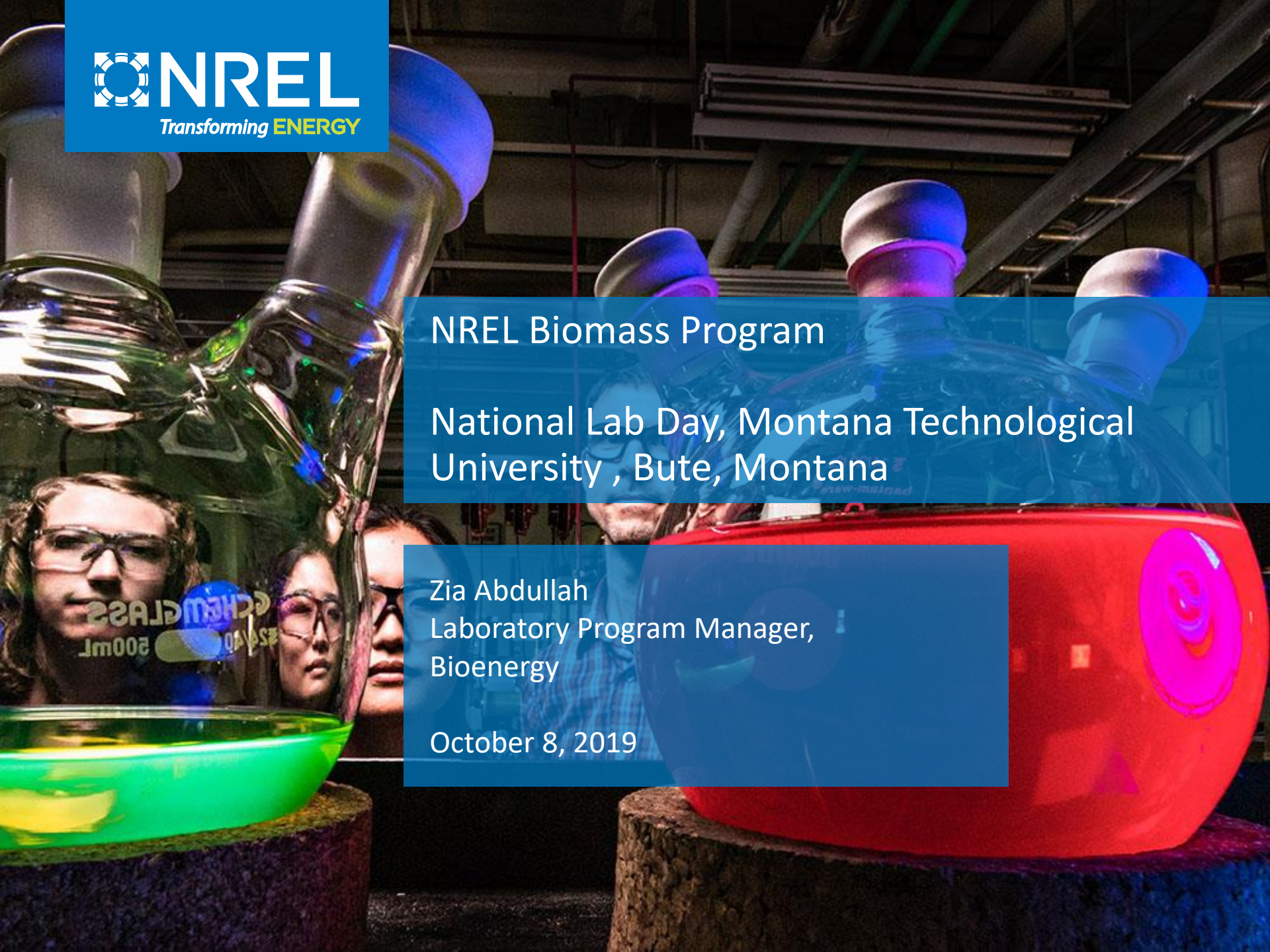
10-8-2019

NREL Biomass Program

Zia Abdullah



NREL Biomass Program

National Lab Day, Montana Technological University , Bute, Montana

Zia Abdullah
Laboratory Program Manager,
Bioenergy

October 8, 2019

NREL at a Glance

2,000

Employees,
plus more than
400
early-career researchers and visiting scientists

World-class
facilities, renowned technology experts

nearly 750

Partnerships
with industry, academia, and government

Campus
operates as a living laboratory

$872M annually

National economic impact

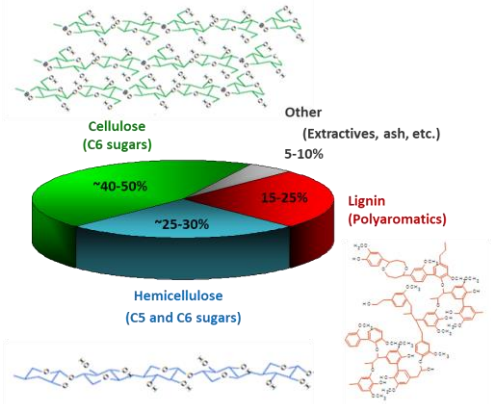
Scope of Mission

Sustainable Transportation	Energy Productivity	Renewable Electricity	Systems Integration	Partners
Vehicle Technologies	Residential Buildings	Solar	Grid Integration of Clean Energy	Private Industry
Hydrogen	Commercial Buildings	Wind	Distributed Energy Systems	Federal Agencies
Biofuels		Water: Marine Hydrokinetics	Batteries and Thermal Storage	State/Local Government
		Geothermal	Energy Analysis	International

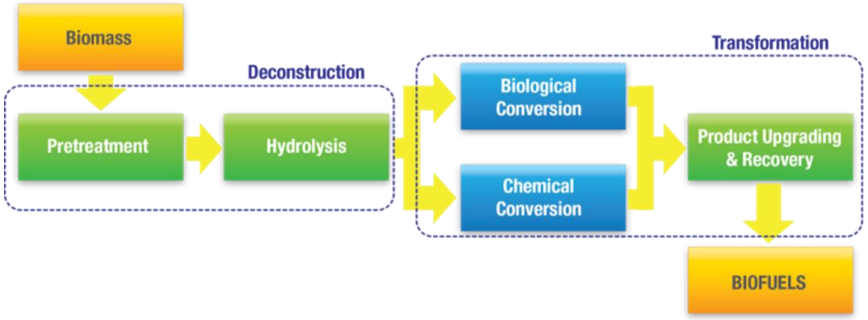


NREL's Research Spans Biochemical and Thermochemical Conversion of biomass to Fuels, Chemical and Products

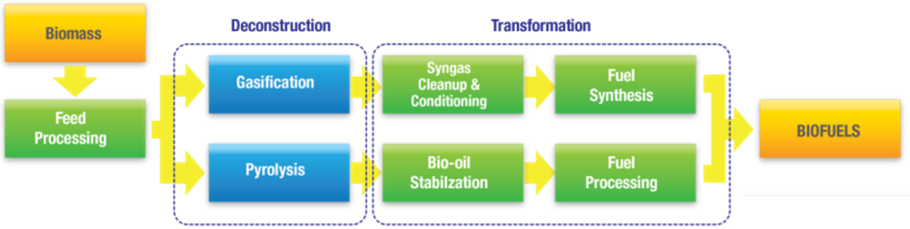
Lignocellulosic Structure of Biomass



Biochemical Conversion

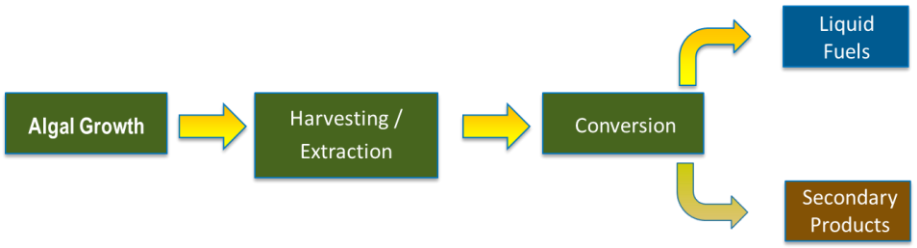


Thermochemical Conversion



Algae

Algae Growth & Conversion



Fuels

Chemicals

Products

ANALYSIS AND SUSTAINABILTY

Can High Energy Jet Fuel be Produced from Biomass?

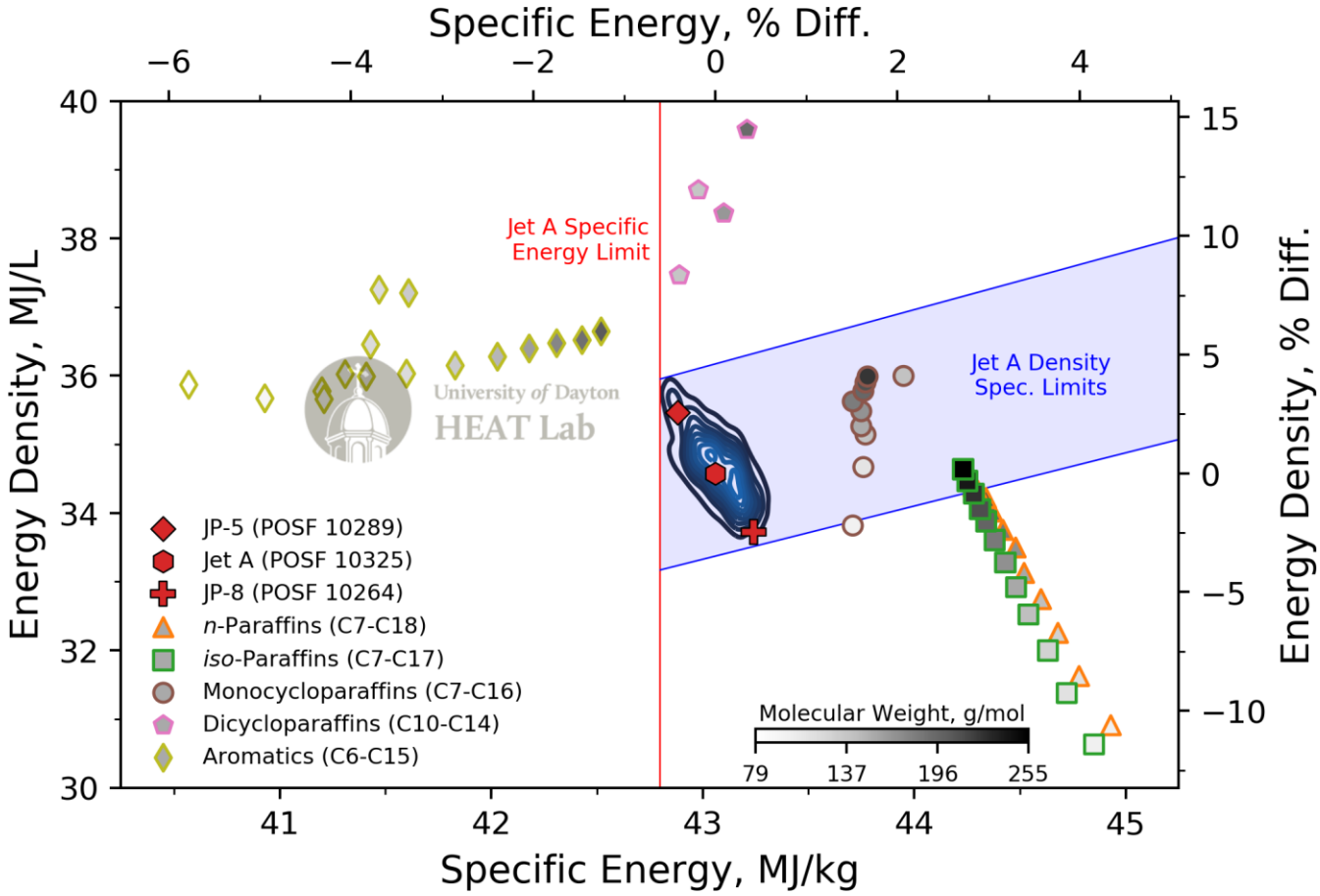
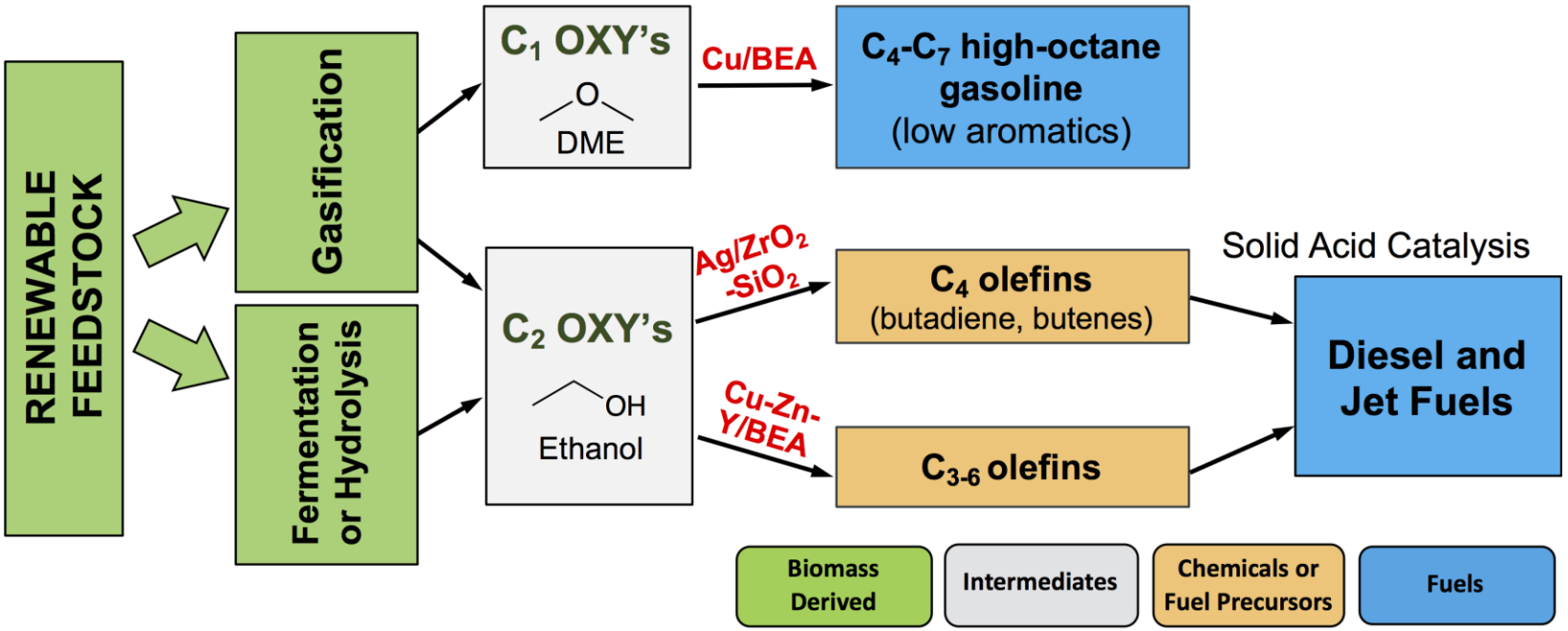
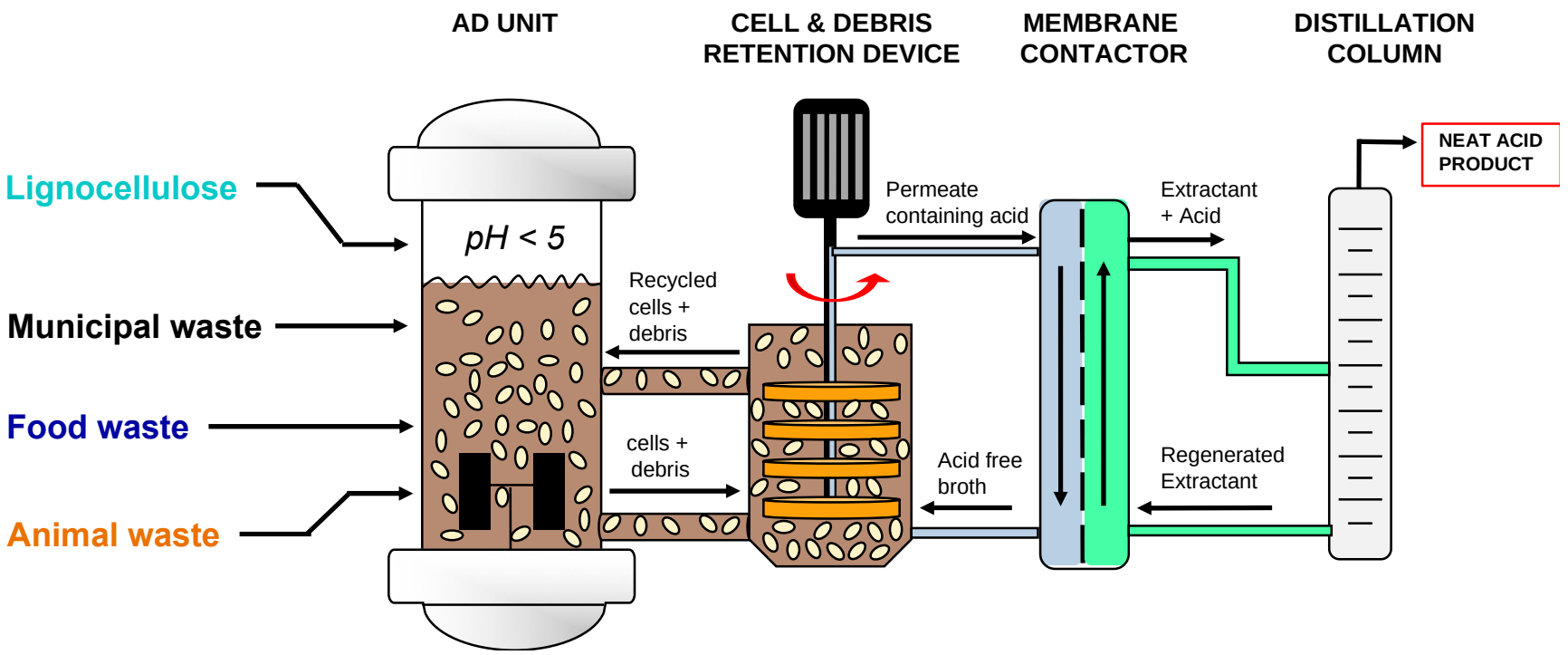


Figure used by permission from Prof. J Heyne, University of Dayton

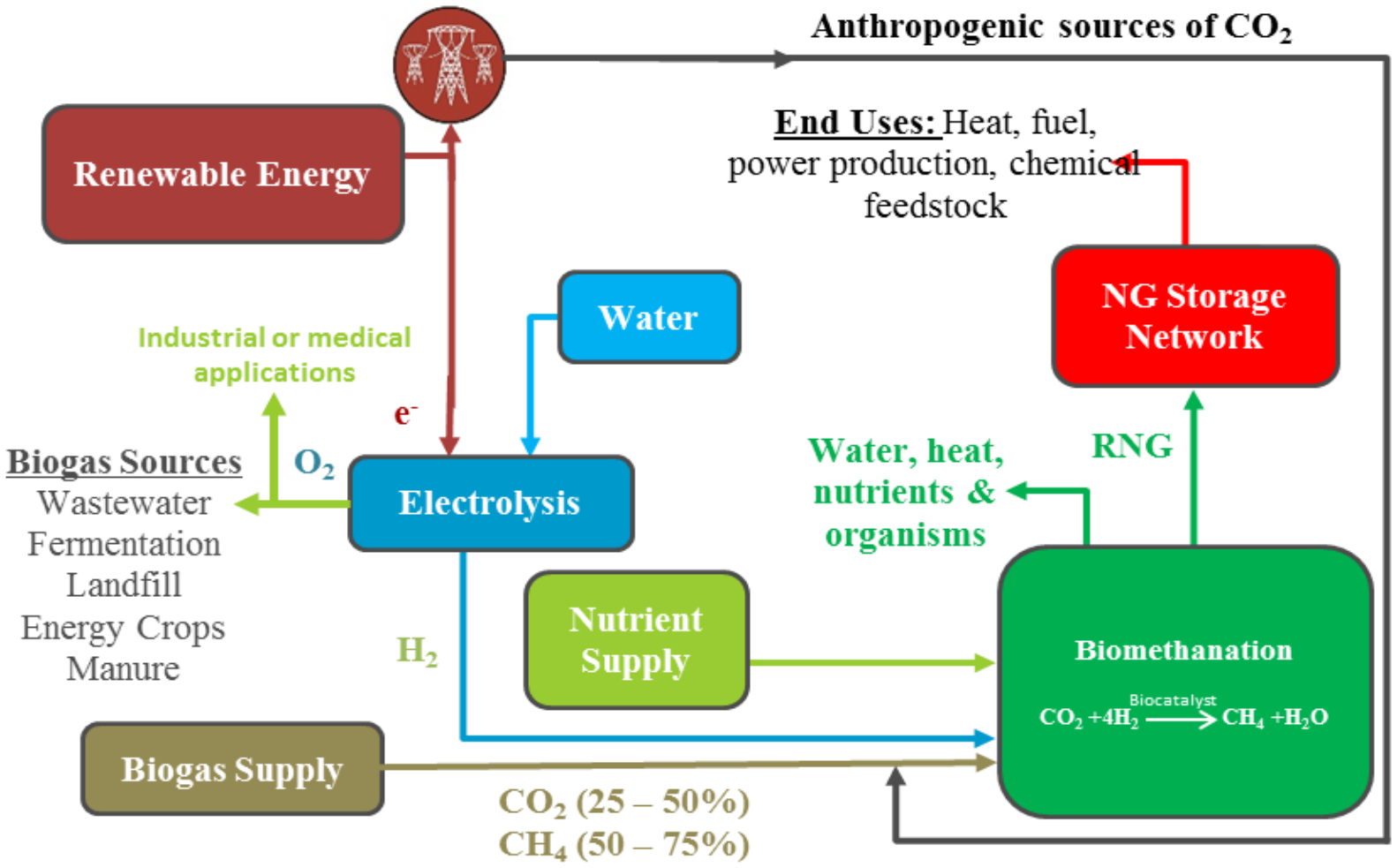
Can High Octane Gasoline be Made from Biomass?



Can Anaerobic Digester Systems Produce Higher Value Products than Natural Gas?

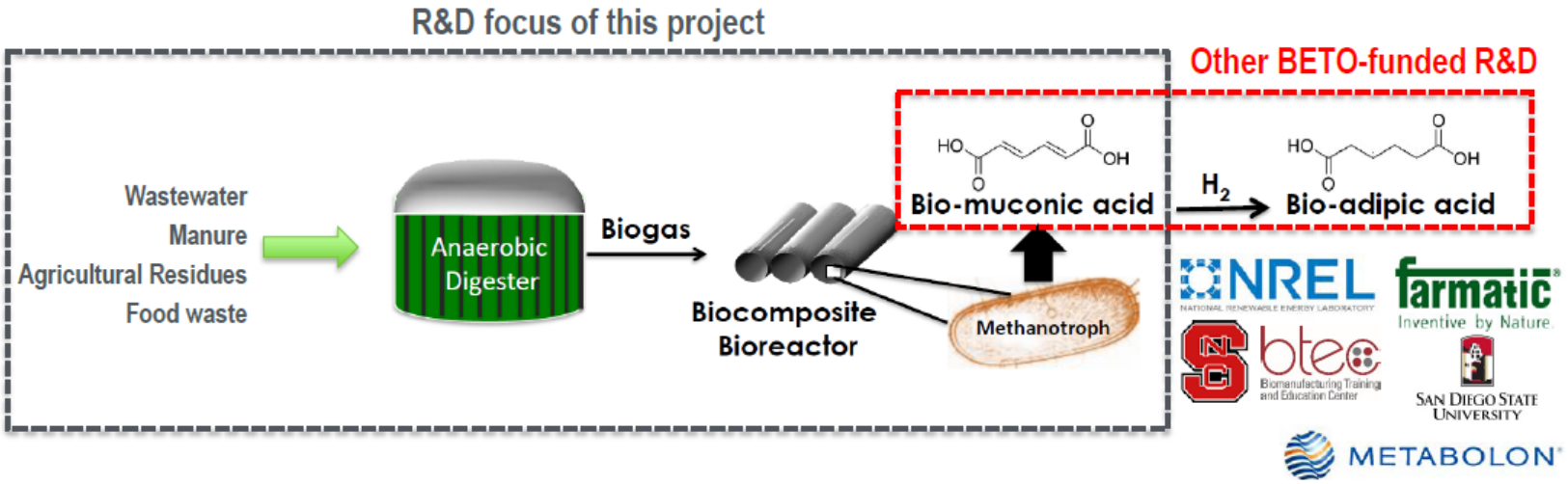


Biomethanation to Upgrade Biogas to Pipeline Grade Methane



Conversion of Biogas to Muconic Acid

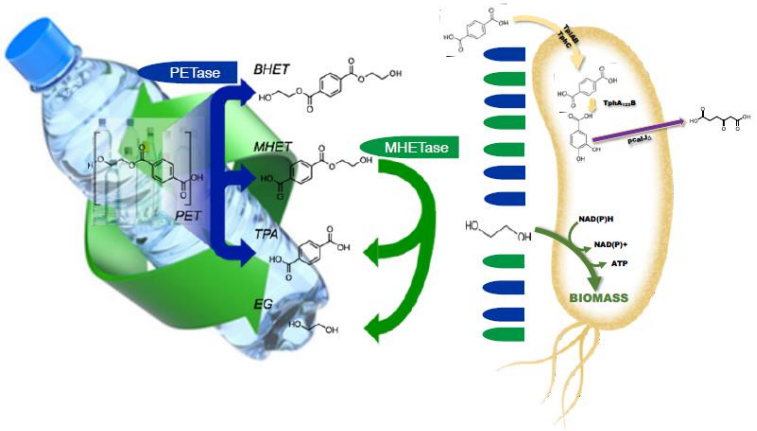
- Project aims to develop a biological process for producing muconic acid from biogas (a precursor to adipic acid and Nylon 6,6)
- Adipic acid is a top 50 bulk chemical (>2M mt/yr) traditionally derived from benzene and cyclohexane[1]. Market price is around $1,600/mt[2]
- The project includes biogas screening on the methanotrophic organism, metabolic engineering, and novel reactor design to improve gas-liquid mass transfer



WBS 2.3.2.201, Mike Guarnieri

Can Plastics be Upcycled to Higher Value Applications?

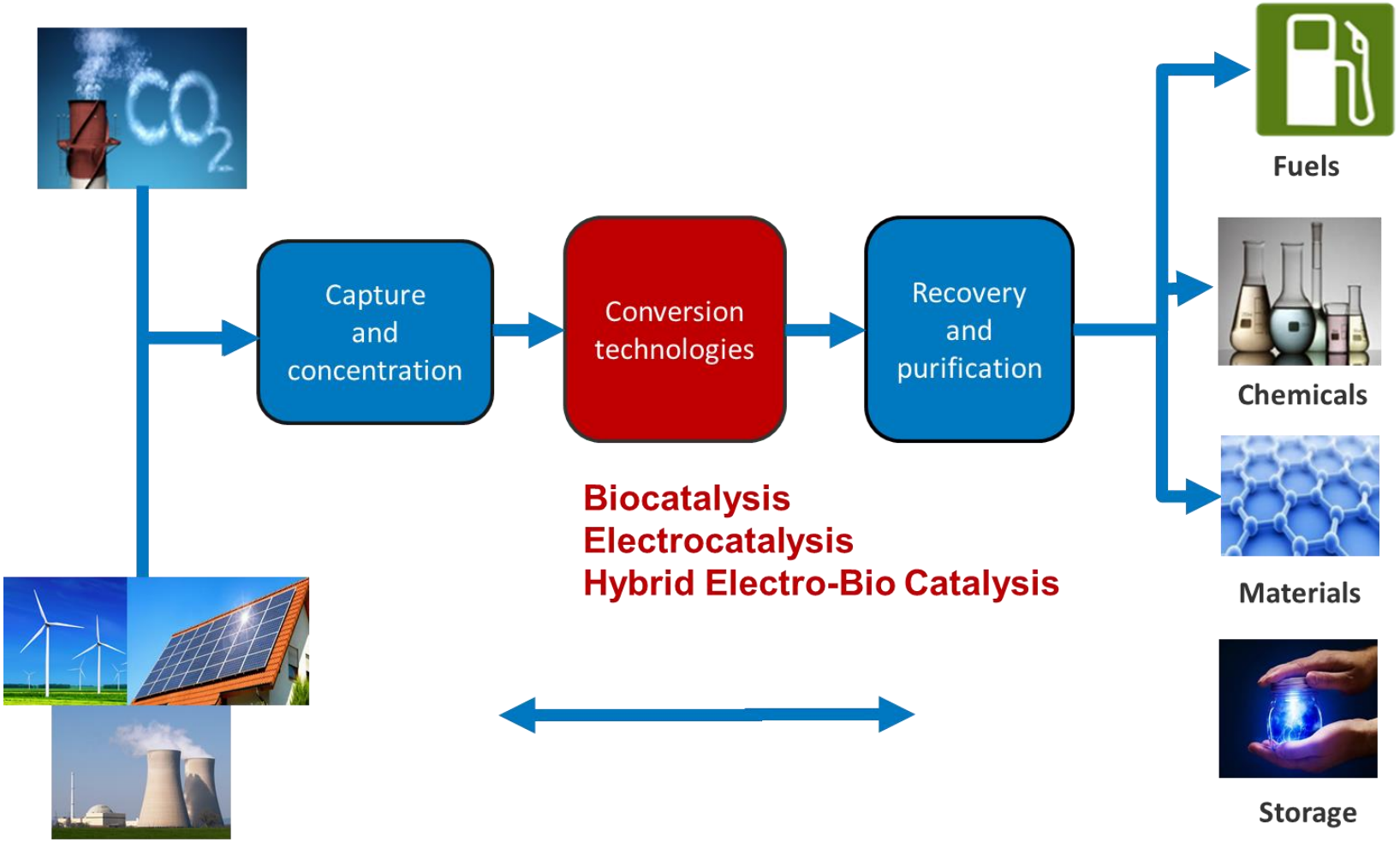
- Plastics recycling today is almost universally down-cycling
- Chemical recycling of PET today is mostly bottle-to-bottle: economics are challenging
- Bio-based solutions (enzymes, microbes, chemical catalysts) towards upcycling can offer a new strategy to advance beyond the State of Technology
- Can ultimately enable new bio-based products from waste plastics



Nylon Precursors

Polymer	T_g (°C)	T_m (°C)
BKA-Nylon	130	-
Adipic-Nylon	60	260

Electrons to Molecules, Adding Value to CO_2 and Utilizing Low Cost, Excess Electrons



Summary

- We have made a lot of progress in utilizing biomass to make fuels, energy and products
- There are many opportunities in:
  - Developing performance advantaged fuels and chemicals from bio resources
  - Using energy from low cost electricity to upgrade CO2, waste gases and biomass

Discussion

NREL
Transforming ENERGY